Abstract No. podo482
Longitudinal Density Modulation of Unstable Bunches
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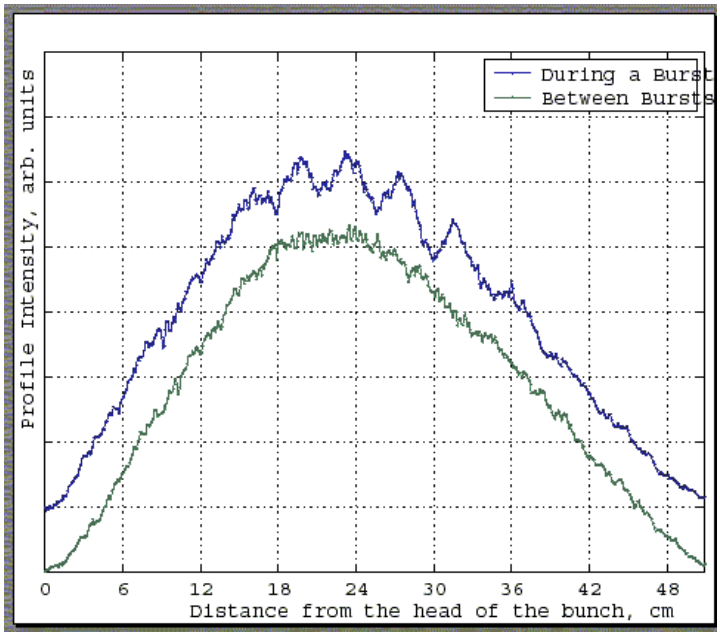
Beamline(s): U3B

Introduction: Observations of coherent IR light emissions from roughly 30 cm long electron bunches at the NSLS VUV ring were reported previously [1]. The emissions occurred above some current threshold and had a maximum spectral content at a wavelength of 7 mm leading to speculations that they were due to a longitudinal instability creating a 7 mm modulation of the bunch density.

Methods and Materials: To check this experimentally we performed detailed bunch shape measurements with a synchroscan Hamamatsu streak camera. This camera was mounted in the U3B optical detector box, which provided the visible light for measuring the bunch current distribution. A parallel data acquisition from high frequency BPM signals (shown to correlate with IR bursts) allowed us to trigger the streak camera data to the time where the coherent emissions took place.

Results: In the course of our studies we have directly proven that the longitudinal beam density indeed experiences significant modulation when coherent emission bursts occur. This modulation of the bunch current is shown below and has a frequency component of about 6.5 GHz , which probably results from the resonance in the vacuum chamber of the shield used to protect the vacuum bellows from heating by the bunch current. Although the wavelength of this modulation is 46mm, not the 7mm seen by the IR beam line, this may be the source of the coherent emission at shorter wavelengths. However, the peak at 7mm maybe the result of constructive interference in of the infrared beam line [2].

References:
[1] G.L. Carr et al., “Observation of coherent synchrotron Radiation from the NSLS VUV ring", NIM **A463**, p387 (2001).
[2] G.L. Carr Proc. "Two-Beam Interference of Long Wavelength Synchrotron Radiation", Particle Accelerator Conference, Chicago, (2001).



Steak camera trace of longitudinal density modulation during the coherent synchrotron radiation burst (upper trace) and between bursts (lower trace).